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Australasian cryptogams—2001 calendar

Heino Lepp and Judith Curnow have produced a 2001 version of their popular cryptogam calendar from last year, in the same format but with additional general text about cryptogams. They're happy to send Acrobat files of sample pages to anybody who's interested. Just send an e-mail request to Judith at:

judith@anbg.gov.au

The cost of the calendar is only NZ$17, which includes air-mail postage. Send a cheque made payable to FORAY ACCOUNT to:

Peter Buchanan
Landcare Research
Private Bag 92170
Auckland, New Zealand

However, please let Judith know too, so that she can send the calendar—Peter doesn't keep stocks.

cover illustration

Austroblastenia pauciseptata grows on the bark of trees in open areas. It's known from Tasmania (the type locality is Mount Wellington) and from both main islands of New Zealand. The genus belongs to the Megalosporaceae, and a second species *A. pupa* also occurs in both Tasmania and New Zealand.

RECENT LITERATURE ON AUSTRALASIAN LICHENS

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OBITUARY—VALE DOUG VERDON, 1920–2000

Douglas Verdon was born in 1920 in Wallasey near Liverpool, England, but was brought up in an orphanage, the National Children's Home on the Isle of Man. His first long-term job (11 years) was as an aircraft mechanic in the Royal Air Force. During World War II, he saw service as a non-combatant in the Middle East, North, East and South Africa, and Italy. He was often in trouble with the British officers for fraternising with Irishmen and Africans! His only belligerent act was to fire an anti-aircraft gun at a German Heinkel, an exchange in which both he and the bomber crew were deliberately trying to avoid killing anyone (i.e., Doug and his Irish mate missed—probably deliberately—and the bomber hit planes on the tarmac but avoided hitting the barracks).

After the war, Doug returned to England and married Eileen, who would be his wife for 49 years. His interest turned from planes to plants, an interest he maintained for the rest of his life. Doug tried his hand at farming in Shropshire, but in 1958, Doug, Eileen, Shelagh, and Robert immigrated to Australia. At first Doug worked at a market garden at Pialligo, near Canberra. He then studied horticulture and spent 23 years (1962–1985) working at the Yarralumla Nursery and the Australian National Botanic Gardens. "Doug's Hybrid" or "Canberry Coronet", a *Telopea* derived from *T. speciosissima* and *T. mongaensis,* was one of his more outstanding successes. While at ANBG, Doug also revealed his latent talent as a taxonomist, an interest which encompassed not only phanerogam taxonomy but also cryptogams and more particularly lichen taxonomy. From 1986 to 1998, Doug worked at the Australian National University, Department of Chemistry, pursuing his post-retirement love, lichen taxonomy and particularly the genus *Leptogium*. In Australia, *Leptogium* includes a complicated array of species and species complexes, which other local lichenologists were more than happy to leave to Doug. He made a number of significant contributions to this genus, describing a series of new species (*Mycotaxon* **37**:413–440, 1990) and a treatment of the genus in the *Flora of Australia* (**54**:173–192, 1992). In addition, he described the new genus *Myelorrhiza* (with Jack Elix) in the family Cladoniaceae, and new species in the genera *Physma* and *Solenospora* (with Gerhard Rambold).

No matter how interesting his own work was, Doug always had time to help a colleague. Whether it was studying obscure ascal tip structure, seeking recalcitrant trychogynes or disappearing microconidia, or translating to and from Latin, he never hesitated to give of his time and expertise in a most generous manner.

Doug had a wonderful, dry sense of humour, and did not mind others telling and retelling the many amusing situations that, inevitably, would confront him. As one outback countryman said of Doug "he is a real wacker", the ultimate compliment for an immigrant from the Isle of Man. A more ardent supporter of the Labour Party than Kim Beasley, Doug had a wonderful sense of humanity, humility and fairness that we shall not forget. We will miss you, old friend.

Jack Elix

Land crabs of Christmas Island eat lichen

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Christmas Island, an Australian territory in the Indian Ocean about 300 km south of Java, is famous for its land crabs, especially the red crab *Gecarcoidea natalis*. Upwards of 100 million individuals inhabit primary rainforest mainly at altitudes of 50–300 m. They make individual burrows in soil and feed primarily on fallen leaves, flowers, fruit and seedlings. Each October/November, at the beginning of the wet season, mature crabs make a spectacular migration to the seashore to breed.

In early August, 2000, following an exceptionally dry July, a brief but heavy rain-shower brought the previously rather sedentary crabs to a high state of activity. They emerged from their burrows and foraged in huge numbers. Some, no doubt suspecting the wet season had arrived, briefly set a rather tentative course for the coast.

In the forest track to Margaret Knoll lookout, near the east coast of the island, I observed one mature crab, its carapace about 10 cm wide, remove a tuft of *Ramalina dumeticola* Krog & Swinscow [syn.: *R. nervulosa* var. *dumeticola* (Krog & Swinscow) G.N. Stevens] from a fallen canopy branch. This richly tufted, narrow-lobed, soraliate lichen, which in the dry state is rather cartilaginous, was soft and easily broken after the rain. With a leaf in one claw and the *Ramalina* in the other, the crab fed very slowly and delicately on one then the other for three or four minutes. In this instance, the animal was not discouraged by the presence of a suite of secondary metabolites in the lichen thallus: sekikaic acid (major), homosekikaic acid (major), 4'-*O*-methylnorhomosekikaic acid (minor) and usnic acid (minor).

I can find no reports in the literature of crabs, either marine or terrestrial, feeding on lichens.

Jack Elix kindly identified a specimen of *R. dumeticola* from Christmas Island, and elucidated its secondary chemistry.

2'-*O*-Methylhiascic acid, a tridepside from the lichen *Melanelia pseudoglabra*

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Abstract: The tridepside 2'-*O*-methylhiascic acid has been detected in extracts of *Melanelia pseudoglabra* together with gyrophoric acid, hiascic acid, 5-*O*-acetyl-4-*O*-methylhiascic acid, and lecanoric acid.

Gyrophoric acid (1) and hiascic acid (2) are common orcinol tridepsides, widely distributed in many lichen genera (Huneck & Yoshimura 1996). A number of hiascic acid derivatives which occasionally co-occur with (1) and (2) show a much more restricted taxonomic distribution and are sometimes species-specific. 5-*O*-acetyl-4-*O*-methylhiascic acid (3) is one such compound, previously known only from the lichen *Koerberiella wimmeriana* (Körber) B. Stein (Elix *et al.* 1991). Similarly, 2'-*O*-methylhiascic acid (4) has been described as only occurring in *Catillaria corymbosa* (Hue) Lamb (Vinet *et al.* 1990). We have prepared authentic 2'-*O*-methylhiascic acid (4) by unambiguous total synthesis (Elix *et al.* 1998) and showed that this compound was dissimilar to the major component of *C. corymbosa*. Indeed, re-extraction of this species confirmed that the major depside present was 5-*O*-methylhiascic acid (5), rather than (4) as originally reported. In this paper we describe the natural occurrence of 2'-*O*-methylhiascic acid (4) together with (1), (2) and (3) in extracts of *Melanelia pseudoglabra* (Essl.) Essl.

Materials and methods

Authentic (synthetic) material of 2'-*O*-methylhiascic acid (4) was prepared by unambiguous total synthesis (Elix *et al.* 1998). Natural compounds were characterized by thin-layer chromatography (TLC) according to the methods standardized for lichen products (Culberson 1972, Elix & Ernst-Russell 1993), and by high-performance liquid chromatography (HPLC) with retention index values (R_I) calculated from benzoic acid and solorinic acid controls (Elix *et al.* 1997, Feige *et al.* 1993). The HPLC was coupled to a photodiode array detector for ultraviolet spectroscopic comparisons. By this means the ultraviolet spectra observed for the various components eluting in the HPLC chromatogram were recorded and computer-matched against a library of ultraviolet spectra recorded for authentic metabolites under identical conditions. For each substance, the correlation of ultraviolet spectra of the synthetic and natural material was greater than 99.9%.

Lichen Material

Melanelia pseudoglabra (Essl.) Essl.
AUSTRALIA. New South Wales: •Abercrombie Caves, 43 km SSE of Blayney, 33°55'S, 149°22'E, 660 m, on *Bursaria spinosa* in disturbed, weedy *Eucalyptus* woodland, *J.A. Elix 25619*, 11 Sept. 1990 (CANB).

Catillaria corymbosa (Hue) Lamb
ANTARCTICA. •Robert Island: Caleta Copper Mine, 33°55'S, 149°22'E, 660 m, on soil and rocks, *C. Vinet & W. Quilhot,* Feb. 1987 (CANB).

Discussion and results

The natural occurrence of 2'-*O*-methylhiascic acid (4) in the extracts *of Melanelia pseudoglabra* has now been confirmed. Comparisons were conducted between the synthetic tridepside (4), the total acetone extracts of *M. pseudoglabra* by TLC in four independent solvent systems, and by HPLC coupled to a photodiode array detector for ultraviolet spectroscopic comparisons. The HPLC of such an extract is shown in Fig. 2. By these means *M. pseudoglabra* was shown to contain gyrophoric acid (1) (major), hiascic acid (2) (minor), 5-*O*-acetyl-4-*O*-methylhiascic acid (3) (minor), 2'-*O*-methylhiascic acid (4) (minor), orcinol (minor), and lecanoric acid (minor). In addition, the lichen *Catillaria corymbosa*, previously reported to contain (4), has been shown to contain the isomeric tridepside 5-*O*-methylhiascic acid (5) as the major medullary component (Fig. 3).

Acknowledgment

We wish to thank Professor J.A. Garbarino, Departamento de Quimica, Facultad de Ciencia, Universidad Técnica Federico Santa Maria, Casilla 110-V, Valparaiso, Chile, for sending us the specimen of *Catillaria corymbosa* used in this study.

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	R_1	R_2	R_3
(1)	H	H	H
(2)	H	OH	H
(3)	Me	OAc	H
(4)	H	OH	Me
(5)	H	OMe	H

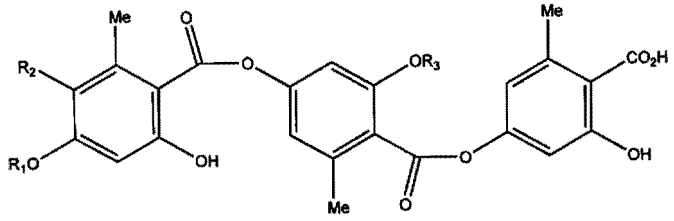

Fig. 1. Structure of tridepsides.

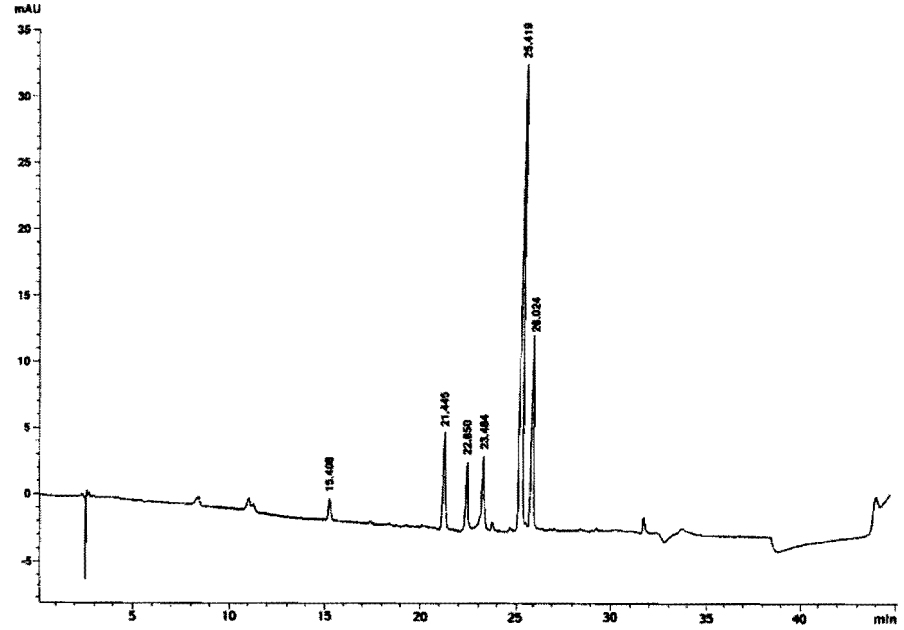

Fig. 2. HPLC of acetone extract *of Melanelia pseudoglabra* (*J.A. Elix 25619*). RT 15.408 = orcinol; RT 21.445 = lecanoric acid; RT 22.650 = 2'-*O*-methylhiascic acid; RT 23.484 = hiascic acid; RT 25.419 = gyrophoric acid; RT 26.024 = 5-*O*-acetyl-4-*O*-methylhiascic acid.

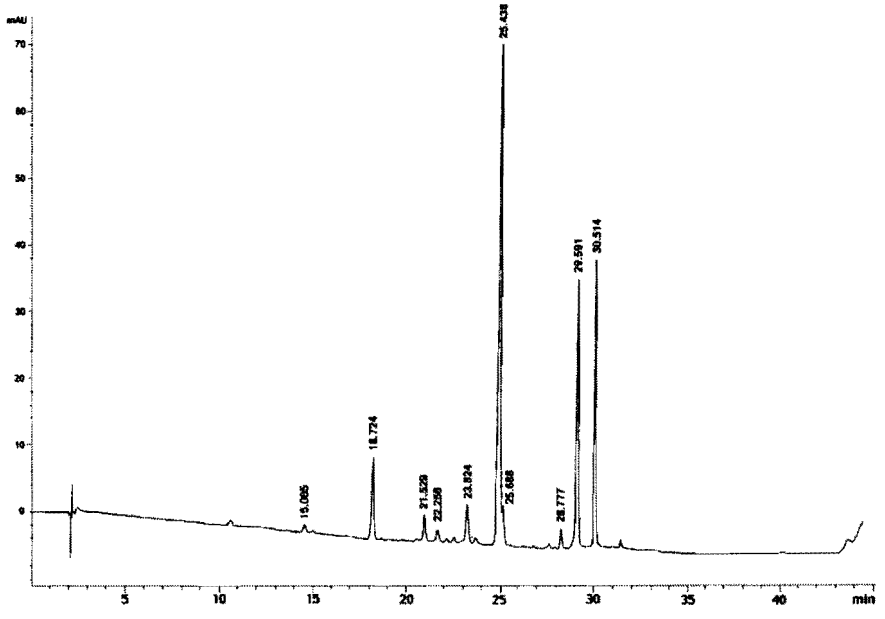

Fig. 3. HPLC *of* acetone extract *of Catillaria corymbosa* (*Vinet & Quilhot*). RT 15.085 = orcinol; RT 18.724 = methyl β-orsellinate; RT 21.529 = lecanoric acid; RT 22.258 = haematommic acid; RT 23.824 = hiascic acid; RT 25.438 = 5-*O*-methylhiascic acid; RT 25.688 = gyrophoric acid; RT 28.777 = usnic acid; RT 29.591 = atranorin; RT 30.514 = chloroatranorin. Methyl β-orsellinate and haematommic acid are most probably artefacts derived by hydrolysis of atranorin.

Variability and ontogenetic process in *Cladonia pertricosa*

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Abstract: Variable morphology in mature specimens of *Cladonia pertricosa* Kremp. can be traced to the morphogenetic patterns of the young thallus. Intercalary growth from areas of "reserve" tissue produces unusual forms in this species, which might otherwise be expected to display predictable growth patterns. The transformation of the thallus from filamentous, recumbent structures to the erect, turgid podetium of mature specimens is noteworthy. It is a growth pattern shared with other Southern Hemisphere Cladoniaceae.

When Krempelhuber (1880) described *Cladonia pertricosa*, based on material from Australia, he gave no rationale for his choice of epithet (*pertricosus*: Lat. "highly confused", "perplexed", or "very strange"). Perhaps the name reflected the morphology of the richly filamentous, fragile young thallus, which Krempelhuber described as growing interwoven amongst mosses. In fact, his description is unclear as to the morphology of the young thallus, which he may have actually confused with moss. In the field and in herbarium specimens, even under the dissecting microscope, it is sometimes impossible to discern the anatomy of the very thin, young thallus, which appears as minute squamules growing along moss or liverwort stems.

Part of this study was aimed at describing the unusual young thallus of *C. pertricosa*. Does the thallus grow on moss or does it simply resemble moss? Further, what ontogenetic changes occur to provide the early recumbent thallus with later podetial structures? Neither Krempelhuber nor Archer (1992) mentioned the radical change of thalli during ontogeny from extremely thin to grossly tumid, yet both morphologies may be found in a single clump of *C. pertricosa* that is several centimetres in diameter. The two states frequently occur without apparent intermediates and with no discernible environmental influence. Krempelhuber noted the cortex of *C. pertricosa*, which he described as "*superficie verruculosa*", but a closer look indicates that the verruculae he observed may have been composed of intercalary meristem tissue which influences the morphogenesis of the species. This short paper discusses some of the unusual phenomena associated with the ontogeny of C. *pertricosa*.

Materials and Methods

Several hundred specimens of *C. pertricosa* were examined for this study. Fresh specimens were field-collected, curated, and distributed through the Farlow Herbarium (FH). Representative specimens include *Hammer 7009, Hammer 7023, Hammer 7104,* and *Streimann 36358*. The specimens (all of which are from Australia and lodged in CANB) were chosen and annotated for their distinctive characteristics. Most of them possess both robust erect podetia and thin, recumbent podetia. Dried specimens at the Australian National Herbarium (CANB) were also studied and annotated. Representative specimens include *EM Canning 4063, JA Elix 1905, JA Elix 1906,* and *JA Elix 3078*. The specimens were examined initially under a dissecting microscope, and selected material was then prepared for scanning electron microscopy (SEM). Air-dried specimens were mounted on aluminium stubs and sputter-coated with gold. They were displayed and photographed on the Cambridge Instruments Stereoscan 360 lanthium hexaboride transmitter at 50 pico amps of electron beam current at 20.0 kv at the Australian National University Electron Microscopy Unit.

Results

The young thallus of *Cladonia pertricosa* is very thin (<1 mm wide), tubular, filamentous, recumbent, and quite delicate. Prominent algal clumps are distributed along the length of the hollow thallus filaments. The algal clumps resemble the leaves of a moss or liverwort macroscopically, but SEM results indicate no involvement with these organisms. The tubular filaments are sparingly branched (Fig. 1). Except for the algal clumps the filaments are composed of fungal hyphae. Later in ontogeny, meristematic regions arise along the filamentous thallus. The meristem-like tissue is composed of fungal cells. In early ontogeny, the meristem generally grows in a tetrad-like formation, with fairly regular divisions occurring along perpendicular axes. The meristem bundles in early ontogeny are oriented to one another at what appears to be prescribed right angles (Fig. 2). The tetrad-like divisions of the meristem can be followed to a later ontogenetic stage, in which four main podetial branches are apparent. Whereas the tetrad is still apparent in the thin branches, the angle of branching has increased, thus introducing a measure of variability early in ontogeny. A further variable is introduced by the bases of the branches which are swollen by irregular thickenings of the thallus. In early ontogeny, thickenings are particularly apparent around the central depression that will later form a perforation (Fig. 3). In addition to a changed angle of branching, the tetrad-like formation of the meristem may become altered through ontogeny. The meristem may enlarge, which is usually a process of elongation of a vermiform structure then widening of a disc-like structure. The meristem may also divide in indeterminate patterns, giving rise to incipient apothecia or large, undulating meristematic bundles (Fig. 4). In later ontogeny, new meristem bundles may arise on any part of the podetium, but especially around the perforations (Fig. 5). In general, the meristem bundles that arise later in ontogeny develop in indeterminate patterns, resulting in pronounced intercalary growth and irregular branching patterns (Fig. 6).

Discussion

In earliest ontogeny, the thallus of *C. pertricosa* seems to bear little morphological relationship to mature podetia and may be mistaken in the field as a separate species. The filamentous thallus superficially resembles a moss, but this study demonstrates that the young, hollow thallus is actually a growth phase of the tubular podetium. As in other *Cladonia* species, the growth of the erect podetium is initiated and partly controlled by fungal meristematic regions which arise on the surface of the young thallus (see Hammer 1993, 1996). The growth patterns of the meristem are variable, and result in an array of seemingly unrelated thallus morphologies that are produced by basic changes in simple tissue shapes (see Hammer 2000). Determinate growth and an unchanging pattern of meristem divisions in C. *pertricosa* produce the thin, fragile podetia with narrow angles of branching, which are generally considered to be characteristic of the species. Indeterminate patterns of meristem splitting and enlarging contribute to irregular growth forms, especially later in ontogeny. These include the tumid, irregularly branched podetia in mature specimens of *C. pertricosa*. Similar patterns of morphological variability based on phenomena of determinate and indeterminate growth were observed in *Cladonia cristatella* Tuck. (Hammer 1997) and *C. subcervicornis* (Vain.) Kernst. (Hammer 1998).

Cladonia pertricosa is also characterised by thickened thallus regions generally composed of lichenised tissue. These regions may provide "reserve tissue" for further growth. They were also observed near the growth tips in *C. leporina* Fr., an unusual, highly variable lichen of the southern United States and the Neotropics

(Ahti 2000, Hammer 2001a). In *C. pertricosa*, the thickened regions may be present near the growth tips or elsewhere on the thallus. They result in a sort of intercalary growth from various regions of the podetial surface, which results in unpredictable thallus shapes in *C. pertricosa*. It is noteworthy that the intercalary growth may involve either lichenised tissue or non-lichenised, exclusively fungal tissue (viz., the fungal meristem). Both tissue types may result in the inflated appearance of the thallus, but branches and apothecia generally originate from meristem morphogenesis.

An important and overlooked feature in *C. pertricosa* is the curious presence of filamentous young thalli along with erect, tumid podetia. The filamentous thalli are developmentally part of the podetia that form later, but functionally (or at least spatially) they are analogous to the primary thallus which gives rise to erect podetia in the genus *Cladonia* Browne. Thus the "primary thallus" of *C. pertricosa* appears to be the recumbent, filamentous form of the normally erect podetium. Generally, the primary thallus in *Cladonia* is a leaflike "squamulose" structure. However, in some *Cladonia* species and in the genus *Cladina* Nyl., the primary thallus is crustose. All of the species in *Cladonia* section *Perviae* (Del.) Matt., in which *C. pertricosa* has traditionally been classified, are characterised by a squamulose primary thallus. The morphology of *C. pertricosa*, in which primary squamules seem to be lacking (although minute podetial squamules do occur occasionally), thus presents a number of problems. The questions that arise are of a taxonomic nature, but more importantly, they require a renewed consideration of evolutionary relationships in the Cladoniaceae and allied lichenised fungi. Should *Cladonia pertricosa* be classified among the species in section *Perviae*? Other sections, for example sect. *Unciales*, are defined taxonomically by the crustose primary thallus. If *C. pertricosa* is included in section *Perviae*, can the group (whose species will consequently possess various patterns of primary thallus development) still be considered as monophyletic? Does the unique morphology of this species indicate a relationship outside of section *Perviae* and perhaps outside of the genus *Cladonia*? Alternatively, does the morphology of *C. pertricosa* provide clues as to the relationship of *Cladonia* with other taxonomic groups?

A comparative morphological analysis may help to provide answers to these questions. For example, the presence of a similar filamentous phase is conspicuous in certain *Cladia* species, particularly in the *C. aggregata* complex (Filson 1981; Galloway 1966, 1976; Kantvilas & Elix 1999). While the filamentous phase is generally erect, it is possible to observe the filamentous thallus in a recumbent position in the field where it often appears to be part of a "wandering" phase of the lichen (see Galløe 1913, 1920, 1954). Further, in *C. aggregata* and other species, the filamentous phase is followed by tumid pseudopodetia that bear little resemblance to the young thallus, similar to the pattern observed in *Cladonia pertricosa*. Is this unusual growth pattern, which has been overlooked in *Cladonia*, a convergent developmental pathway that has arisen numerous times? If so, why is it generally absent from Northern Hemisphere Cladoniaceae? Alternatively, might it be an inherited phenomenon, indicating a closer relationship between *Cladia* and certain *Cladonia* species than previously suspected? Does it suggest a Gondwanan origin for the Cladoniaceae, in which certain inherited morphological trends have been carried along with the species that radiated northward? A recent paper (Hammer 2001b) explored relationships among distantly related groups in the Cladoniaceae, based on their early morphogenetic patterns. Further studies should focus on shared morphogenetic patterns among the Cladoniaceae and allied lichen groups with an emphasis on taxa native to the Southern Hemisphere.

Acknowledgments

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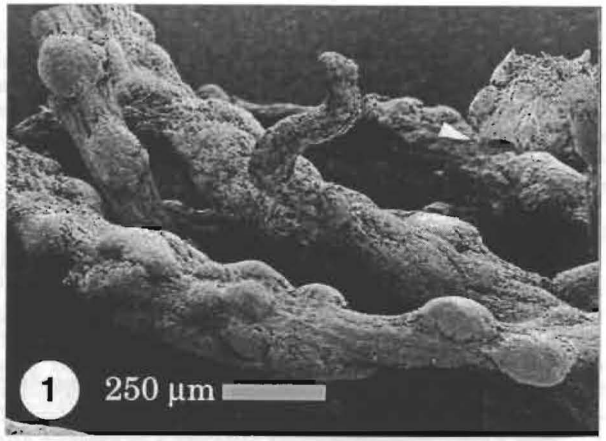

Figure 1. Earliest ontogeny. The hollow filamentous thallus (arrow) is sparingly branched. Its surface is covered with algal clumps whose shape suggests they experience limited expansion along the growth axis of the filament.

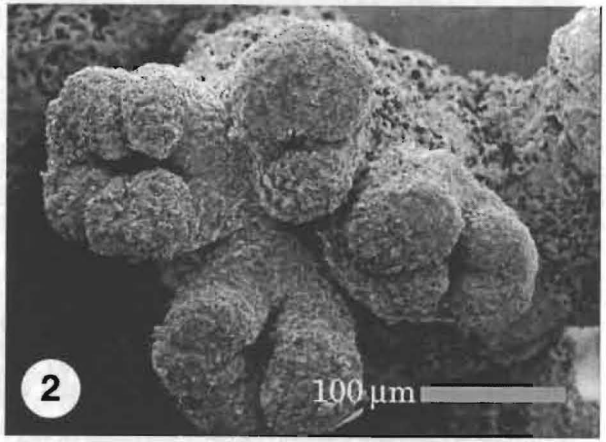

Figure 2. Fungal meristem bundles in a tetrad-like arrangement dividing at regular angles.

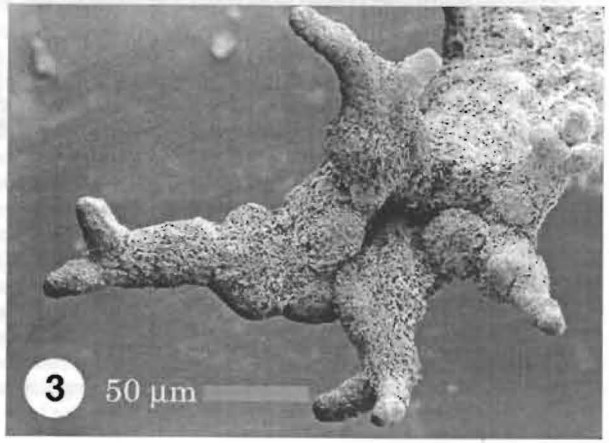

Figure 3. Later ontogeny in which four thin podetial branches extend from a central depression. The branches are ontogenetically descended from the tetrad-like meristem. Note the thick branch bases, from which intercalary growth can proceed.

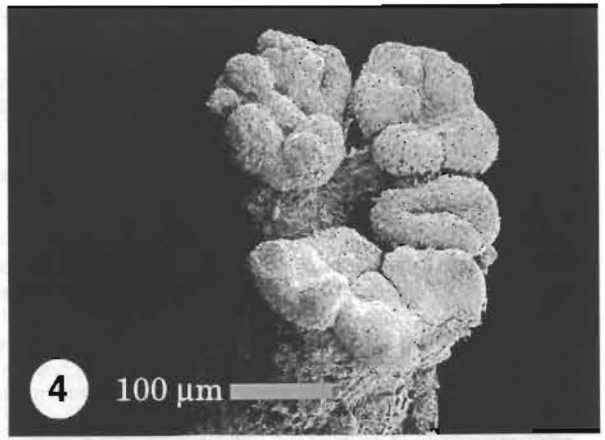

Figure 4. Incipient apothecia and large, undulating meristem bundles that arise from indeterminate divisions of the fungal meristem tissue.

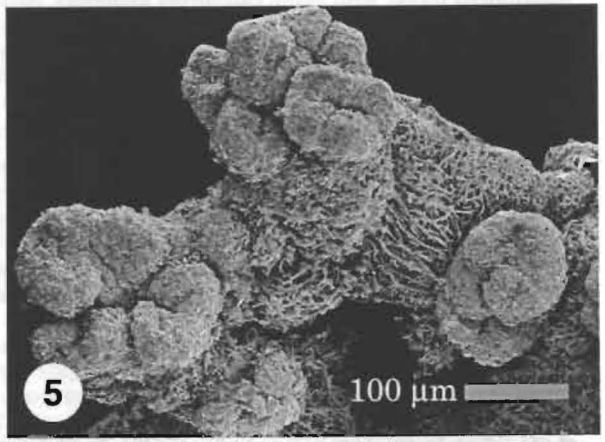

Figure 5. Intercalary meristem bundles forming in the vicinity of a central perforation (dark area at bottom centre of figure). The bundles enlarge by elongation and divide in irregular patterns.

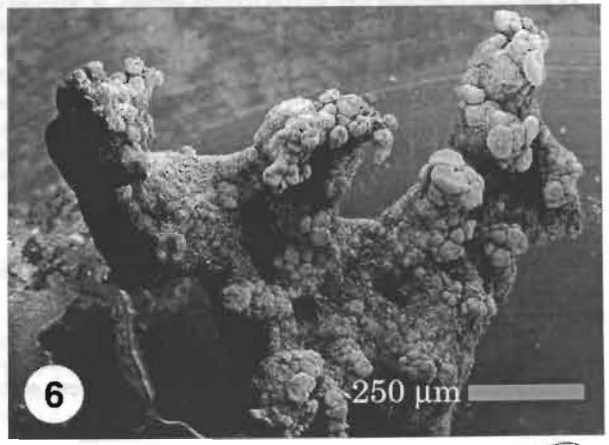

Figure 6. Habit of maturing podetium. Note the incipient apothecia and the erumpent meristematic regions covering the surface of the podetium.

Foliicolous lichens in Tasmania

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Abstract: Twenty-five foliicolous lichen species are reported from Tasmania. Most inhabit leaves of the tree *Atherosperma moschatum* and fronds of the fern *Blechnum wattsii* in the comparatively mild, eastern and south-eastern parts of the island, mainly in sheltered gullies containing relict rainforest vegetation, or wet-sclerophyll forest with some rainforest elements. Apart from two cosmopolitan taxa, the flora is equally divided between predominantly tropical species and more or less exclusively southern-temperate species, four of which are known only from Tasmania. *Aspidothelium cinerascens, Porina atrocoerulea, Porina leptosperma* and *Porinula setifera* are reported for the first time from Australia.

Introduction

Foliicolous lichens are absent or very poorly represented in cool-temperate regions of the Northern Hemisphere. In contrast, these organisms are well-established under equivalent climatic conditions in southern-temperate latitudes, being considerably closer to the extremely diverse subtropical and tropical foliicolous floras. Although not studied in great detail, foliicolous communities occur in southern South America, southern New Zealand and in the rainforests and wet-sclerophyll forests of south-eastern Australia.

Intensive collection of Tasmanian foliicolous lichens began in 1989, and today the flora is known to comprise at least 25 obligate or facultative, foliicolous species. Several new taxa have already been described from Tasmanian localities or mentioned in the recent literature (Kantvilas & Vězda 1988; Kantvilas 1990; Malcolm *et al.* 1999; McCarthy & Kantvilas 2000a, b; McCarthy *et al.* 2000).

In Tasmania, foliicolous communities are most diverse and abundant in cool-temperate rainforest at altitudes up to 600 m and in remnants of rainforest in sheltered gullies. Foliicolous lichens have been collected at almost 50 localities throughout the island. They occur on 15 host species, including the endemic conifers *Athrotaxis cupressoides, Diselma archeri, Lagarostrobos franklinii, Microstrobos niphophilus* and *Phyllocladus asplenifolius*. However, two phorophytes are especially favoured: the broad-leaved tree *Atherosperma moschatum* and the robust fern *Blechnum wattsii*.

The Species

All of the specimens cited are held in the Tasmanian Herbarium, Hobart (HO).

Arthonia cyanea Müll. Arg., *Flora* **64**, 233 (1881)
In Tasmania, this pantropical species grows on leaves of *Atherosperma moschatum* and pinnae of *Blechnum wattsii* in rainforest and wet-sclerophyllous vegetation with remnant rainforest elements in sheltered gullies and gorges below 600 m. For a full description, see Santesson (1952).

SELECTED SPECIMENS EXAMINED (n = 22; 14 localities; 2 host species)
•Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *Kantvilas 347/89*, 10.xii.1989; •c. 1.5 km NW of Liapootah Power Station, 42°22'S, 146°30'E, alt. 360 m, *Kantvilas 305/90*, 4.viii.1990; •Myrtle Gully (above terminus of Old Farm Road), 42°54'S, 147°15'E, alt. 400 m, *Kantvilas 37/99*, 30.i.1999; •Bermuda Road, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 46/99*, 9.ii.1999; •Douglas-Apsley Natl Park, Myrtle Creek headwaters, 41°48'S, 148°07'E, alt. 450 m, *Kantvilas 208/99*, 16.v.1999.

Arthonia trilocularis Müll. Arg., *Flora* **64**, 233 (1881)
This pantropical lichen occurs on leaves of *Atherosperma moschatum* and pinnae of *Blechnum wattsii* and *Polystichum proliferum* in rainforest and in remnants of rainforest in sheltered gullies and gorges below 600 m. For a full description, see Santesson (1952).

SELECTED SPECIMENS EXAMINED (n = 21; 10 localities; 3 host species)
•c. 1.5 km NW of Liapootah Power Station, 42°22'S, 146°30'E, alt. 360 m, *Kantvilas 302/90*, 4.viii.1990; •Mt Wellington, Betts Vale, 42°55'S, 147°15'E, alt. 530 m, *Kantvilas 42/99*, 30.i.1999; •Meetus Falls, 41°57'S, 147°53'E, alt. 510 m, *Kantvilas 191/99*, 16.v.1999; •Douglas-Apsley Natl Park, Myrtle Creek headwaters, 41°48'S, 148°07'E, alt. 450 m, *Kantvilas 208/99*, 16.v.1999; •saddle on Coolangatta Rd, Bruny Island, 43°21'S, 147°17'E, alt. 440 m, *Kantvilas 376/99*, 27.xi.1999.

Aspidothelium cinerascens Vain., *Acta Soc. Fauna Fl. Fenn.* **7**, 189 (1890)
Already known from the Neotropics and New Zealand, *A. cinerascens* grows on leaves of *Atherosperma moschatum* in *Eucalyptus obliqua*-dominated wet forest in southern Tasmania. This species has also been recorded in Tasmania from the bark of *Nothofagus cunninghamii* twigs in cool-temperate rainforest. These are the first Australian records of this lichen. For descriptions, see Santesson (1952) and Malcolm & Vězda (1995c).

SPECIMENS EXAMINED
•W of Tahune Bridge, "Big Coupe", Warra SST, 43°06'S, 146°41'E, alt. 120 m, on leaves, *Kantvilas 224/99*, 19.v.1999; •Pelion Plains, c. 1 km SW of Pelion Hut, 41°50'S, 146°02'E, alt. 900 m, on bark, *Kantvilas 218/92*, 12.iii.1992.

Badimiella serusiauxii Malcolm & Vězda, *Nova Hedwigia* **59**, 519 (1994)
This lichen occurs in rainforest and wet-sclerophyll forest on the fronds of the ferns *Blechnum wattsii, Microsorum diversifolium* and *Polystichum proliferum*, and on the leaves of *Atherosperma moschatum, Olearia argophylla* and *Richea pandanifolia*. It is found in most foliicolous communities in Tasmania, and it is the most frequent and abundant species above 600 m. It is probably the most common and conspicuous foliicolous lichen in Tasmania, typically only occurring in the campylidial state. *Badimiella serusiauxii* is also known from southern Victoria, eastern New South Wales and New Zealand. For a full description, see Malcolm & Vězda (1994).

SELECTED SPECIMENS EXAMINED (n = 34; 18 localities; 6 host species)
•Weindorfers Forest, 41°38'S, 145°56'E, alt. 940 m, *Kantvilas 18/90*, 9.i.1990; •c. 1.5 km SSE of Platform Peak, 42°42'S, 147°04'E, alt. 510 m, *Kantvilas 285/90*, 31.v.1990; •South Picton Range, track to Square Tarn, 43°12'S, 146°37'E, alt. c. 600 m, *Kantvilas 15/99*, 20.i.1999; •Bermuda Road, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 47/99*, 9.ii.1999; •Meetus Falls, 41°57'S, 147°53'E, alt. 510 m, *Kantvilas 192/99*, 16.v.1999.

Bullatina microcarpa (Vězda) Brusse, *Mycotaxon* **49**, 11 (1993)
Syn.: *Calenia microcarpa* Vězda, *Folia Geobot. Phytotax.* **14**, 55 (1979)
This very distinctive species is known from Africa, South-East Asia, eastern Australia and New Zealand. For a full description, see Vězda (1979, as *Calenia microcarpa*).

SELECTED SPECIMENS EXAMINED (n = 12; 8 localities; 3 host species)
•Forest Track, below Mt Victoria, c. 41°20'S, 147°50'E, *G.C. Bratt & J.A. Cashin*, 24.xi.1973; •Lower Pieman Dam Road, 41°44'S, 145°28'E, alt. 180 m, *Kantvilas 23/90*, 11.i.1990; •Robertsons Bridge, Wielangta Forest Road, 42°42'S, 147°50'E, alt. 190 m, *Kantvilas 289/90*, 23.vii.1999; •Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *A. Shapcott*, v.1991; •Pruana Road, c. 3 km S of Meunna, 41°07'S, 145°29'E, alt. 320 m, *Kantvilas 490/92 et al.*, 18.v.1992.

Byssoloma leucoblepharum (Nyl.) Vain., *Dansk Bot. Ark.* **4**, 23 (1926)
This facultatively corticolous species is common throughout tropical and subtropical regions. In Tasmania, it occurs on leaves of *Atherosperma moschatum* in callidendrous rainforest. For a full description, see Santesson (1952).

SPECIMEN EXAMINED
•Five Mile Road, near Little Florentine R., 42°44'S, 146°25'E, alt. 440 m, *J. Jarman*, 16.v.1995.

Byssoloma subdiscordans (Nyl.) P. James, *Lichenologist* **5**, 126 (1971)
This cosmopolitan lichen also grows on bark (including in Tasmania) and siliceous rocks. It occurs on leaves of *Atherosperma moschatum* and *Richea pandanifolia*. For a full description, see James (1971).

SPECIMENS EXAMINED
•Weindorfers Forest, 41°38'S, 145°56'E, alt. 940 m, *Kantvilas 19/90*, 9.i.1990; •c. 1.5 km SSE of Platform Peak, 42°42'S, 147°04'E, alt. 510 m, *Kantvilas 285/90*, 31.v.1990; •Yarlington Tier, 42°32'S, 147°18'E, alt. 620 m, *Kantvilas 309/91*, 17.x.1991; •Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *Kantvilas s.n.*, 12.vii.1997; •Bermuda Road, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 46/99*, 9.ii.1999.

Byssoloma subundulatum (Stirt.) Vězda, *Folia Geobot. Phytotax.* **21**, 216 (1986)
One of the most common and abundant foliicolous species in Tasmania, *B. subundulatum* also occurs in eastern Queensland and New South Wales and in New Zealand. For a full description, see Santesson (1952, as *Bacidia subundulata*).

SELECTED SPECIMENS EXAMINED (n = 25; 11 localities; 4 host species)
•Flash Tier, near Seventeen Acre Creek, 42°36'S, 147°53'E, alt. 300 m, *Kantvilas 325/90*, 10.x.1990; •Yarlington Tier, 42°32'S, 147°18'E, alt. 620 m, *Kantvilas 309/90*, 17.x.1991; •Bermuda Road, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 47/99*, 9.ii.1999; •Meetus Falls, 41°51'S, 147°53'E, alt. 510 m, *Kantvilas 193/99*, 16.v.1999; •Douglas-Apsley Natl Park, Myrtle Creek headwaters, 41°48'S, 148°07'E, alt. 450 m, *Kantvilas 206/99, 207/99*, 16.v.1999.

Enterographa bella R. Sant., *Symb. Bot. Upsal.* **12**(1),106 (1952)
First described from New Zealand, this lichen was recently reported from southern Victoria (Ralston 1999). The Tasmanian specimens grow on leaves of *Atherosperma moschatum* and the climber *Parsonsia brownii* in a moist, sheltered gully. For a full description, see Santesson (1952).

SPECIMENS EXAMINED
•Track to Cape Surville, 42°57'S, 147°59'E, alt. c. 110 m, *Kantvilas 404/00*, 21.xi.2000; •*loc. id., Kantvilas 405/00*, 21.xi.2000.

Fellhanera bouteillei (Desm.) Vězda, *Folia Geobot. Phytotax.* **21**, 214 (1986)
This cosmopolitan lichen also grows on twigs and siliceous rocks. For a full description, see Santesson (1952, as *Catillaria bouteillei*).

SELECTED SPECIMENS EXAMINED (n = 10; 6 localities; 2 host species)
•Wyfield Rivulet, *A. Shapcott*, 16.vii.1991; •Meetus Falls, 41°57'S, 147°53'E, alt. 510 m, *A. Shapcott*, 15.vii.1991; •Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *Kantvilas s.n.*, 12.vii.1997; •Douglas-Apsley Natl Park, Myrtle Creek headwaters, 41°48'S, 148°07'E, alt. 450 m, *Kantvilas 209/99*, 16.v.1999.

Fellhanera endopurpurea Hafellner & Vězda, in Vězda & Hafellner, *Nova Hedwigia* **52**, 76 (1991).
First described from north-eastern New South Wales and south-eastern Queensland, the Tasmanian specimens attributed here to *F. endopurpurea* exhibit a much broader range of thallus and ascomatal anatomy and possibly represent more than one taxon. For a full description of *F. endopurpurea*, see Vězda & Hafellner (1991).

SELECTED SPECIMENS EXAMINED (n = 30; 16 localities; 4 host species)
•Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *Kantvilas 347/89*, 10.xii.1989; •Wyfield Rivulet, *A. Shapcott*, 16.vii.1991; •Meetus Falls, 41°57'S, 147°53'E, alt. 510 m, *A. Shapcott*, 15.vii.1991; •Mt Wellington, Betts Vale, 42°55'S, 147°15'E, alt. 530 m, *Kantvilas 39/99*, 20.i.1999; •Myrtle Gully (above terminus of Old Farm Road), 42°54'S, 147°15'E, alt. 400 m, *Kantvilas 37/99*, 30.i.1999; •Myrtle Creek headwaters, Douglas-Apsley Natl Park, 41°48'S, 148°07'E, alt. 450 m, *Kantvilas 207/99*, 16.v.1999.

Kantvilasia hians P.M. McCarthy, Elix & Sérus., *Lichenologist* **32**, 319 (2000)
Recently described from north-western Tasmania, it is also known from southern Tasmania and from almost identical latitudes in southern Argentina and Chile. For a full description, see McCarthy *et al.* (2000).

ADDITIONAL SPECIMEN EXAMINED
•Tahune Bridge, 43°06'S, 146°44'E, *Kantvilas 353/99*, 1.xi.1999.

Mazosia phyllosema (Nyl.) Zahlbr., *Catal. Lich. Univ.* **2**, 503 (1923)
A pantropical lichen that is known from pinnae of *Blechnum wattsii* and leaves of *Atherosperma moschatum* in south-eastern and western Tasmania. For a full description, see Santesson (1952).

SELECTED SPECIMENS EXAMINED (n = 8; 4 localities; 2 host species)
•Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *Kantvilas s.n.*, 12.vii.1997; •Mueller Road, at start of track to Mt Mueller, 42°48'S, 146°31'E, alt. 640 m, *Kantvilas 6/98*, 21.ii.1998; •Mt Wellington, Betts Vale, 42°55'S, 147°15'E, alt. 530 m, *Kantvilas 39/99*, 20.i.1999; •Bermuda Road, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 45/99*, 9.ii.1999.

Porina atrocoerulea Müll. Arg., *Flora* **66**, 336 (1883)
This common pantropical species is reported here for the first time from Australia. The Tasmanian specimen grows on leaves of the climber *Parsonsia brownii* in a moist, sheltered gully. For a full description, see Santesson (1952).

SPECIMEN EXAMINED
•Track to Cape Surville, 42°57'S, 147°59'E, alt. c. 110 m, *Kantvilas 405/00*, 21.xi.2000.

"Porina blechnicola"
This undescribed species is known from southern and western Tasmania, where it grows on fronds of *Blechnum wattsii* in cool-temperate rainforest.

SPECIMENS EXAMINED
•Site W 468, Anthony Rd, *S.J. Jarman s.n.*, 12.xi.1992; •South Picton Range, track to Square Tarn, 43°12'S, 146°37'E, alt. c. 600 m, *Kantvilas 14/99*, 20.i.1999; •Bermuda Rd, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 45/99, 47/99, 52/99, 53/99*, 9.ii.1999; •northern slopes of Mt Riveaux, 43°08'S, 146°39'E, alt. c. 700 m, *Kantvilas 129/00*, 21.iii.2000.

Porina leptosperma Müll. Arg., *Flora* **66**, 333 (1883)
Surprisingly, this pantropical lichen is not known from tropical Australia, although it does occur in New Zealand. It is very rare in western Tasmania, where it grows on a frond of *Blechnum wattsii*. This is the first Australian record of this lichen. For a full description, see Santesson (1952).

SPECIMEN EXAMINED
•Corinna, southern side of Pieman R., *Kantvilas 44/00*.

Porina subapplanata Malcolm, Vězda, P.M. McCarthy & Kantvilas, *Australas. Lichenol.* **45**, 22 (1999)
This very common foliicolous lichen also occurs on bark and green twigs. Recently described from Tasmania, Victoria and New Zealand, it is also known from eastern New South Wales. In Tasmania it is known from five hosts at 15 localities. For a full description and a partial list of Tasmanian localities, see Malcolm *et al.* (1999).

Porinula setifera Malcolm & Vězda, *Folia Geobot. Phytotax.* **30**, 317 (1995)
Previously reported from southern New Zealand, in Tasmania *P. setifera* is known from a rainforest remnant in a gorge on the east coast. It grows near the margins and tips of leaves of *Atherosperma moschatum*. These are the first Australian records of this lichen. For a full description, see Malcolm & Vězda (1995b).

SPECIMENS EXAMINED
•Meetus Falls, 41°57'S, 147°53'E, alt. 510 m, *Kantvilas 186/99*, 16.v.1999; •*loc. id.*, *A. Shapcott*, 15.vii.1991.

Roccellinastrum flavescens Kantvilas, *Lichenologist* **22**, 81 (1990)
This species is known only from the leaves of the Tasmanian endemic conifers *Athrotaxis cupressoides*, *Diselma archeri* and *Microstrobos niphophilus* in the Central Highlands at altitudes above 1200 m. For a full description and a partial list of localities, see Kantvilas (1990).

Roccellinastrum lagarostrobi Kantvilas, *Lichenologist* **22**, 83 (1990)
This lichen inhabits the green leafy twigs of the Tasmanian endemic conifer *Lagarostrobos franklinii* in south-western Tasmania. It also occurs on the dead and living leaves of *Richea pandanifolia* and *R. scoparia*. For a full description and a partial list of localities, see Kantvilas (1990). Since its initial description, based on sterile material, it has been discovered with apothecia and bacilliform, 1(–2)-septate ascospores, 9.5–12 × 2–3 µm.

Strigula nitidula Mont., in de la Sagra, *Hist. Phys. Cuba, Bot. Pl. Cell.* **9**, 184 (1838–1842)
This ubiquitous tropical species is very rare in Tasmania. The small number of thalli observed occur near holes and fractures in *Atherosperma moschatum* leaves. For a full description, see Santesson (1952).

SPECIMENS EXAMINED
•Robertsons Bridge, Sandspit R., 42°58'S, 147°50'E, alt. 190 m, *Kantvilas 327/90*, 10.x.1990; •Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *Kantvilas s.n.*, 12.vii.1997; •c. 2 km SW of Stormont, 41°31'S, 146°00'E, alt. 800 m, *Kantvilas 306/99*, 27.vi.1999.

Tapellaria phyllophila (Stirt.) R. Sant., in Thorold, *J. Ecol.* **40**, 129 (1952)
Known from eastern Queensland and New South Wales, New Zealand and the Neotropics, *T. phyllophila* is locally abundant in Tasmania, almost always growing on leaves of *Atherosperma moschatum*. For a full description, see Santesson (1952).

SELECTED SPECIMENS EXAMINED (n = 10; 7 localities; 2 host species)
•Forest Track, below Mt Victoria, c. 41°20'S, 147°50'E, *G.C. Bratt & J.A. Cashin*, 24.xi.1973; •Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *A. Shapcott*, v.1991; •Pruana Road, c. 3 km S of Meunna, 41°07'S, 145°29'E, alt. 320 m, *Kantvilas 490/92 et al.*, 18.v.1992; •Meetus Falls, 41°57'S, 147°53'E, alt. 510 m, *Kantvilas 186/99*, 16.v.1999; •Douglas-Apsley Natl Park, Myrtle Creek headwaters, 41°48'S, 148°07'E, alt. 450 m, *Kantvilas 209/99*, 16.v.1999.

Trichothelium javanicum (F. Schill.) Vězda, *Nova Hedwigia* **58**, 139 (1994)
An uncommon species in Tasmania, *T. javanicum* is known only from the fronds of the ferns *Microsorum diversifolium* and *Blechnum wattsii*. This lichen also occurs in Java, eastern and south-eastern mainland Australia, Lord Howe Island and New Zealand (where it also grows on aquatic siliceous rocks). For a description, see McCarthy & Johnson (1995).

SPECIMENS EXAMINED
•Robertsons Bridge, Sandspit R., 42°58'S, 147°50'E, alt. 190 m, *Kantvilas 327/90*, 10.x.1990; •Junee Cave, 42°44'S, 146°36'E, alt. 300 m, *Kantvilas 77/00*, 16.ii.2000.

Trichothelium meridionale P.M. McCarthy & Kantvilas, *Australas. Lichenol.* **47**, 5 (2000)
This endemic species is known from fronds of *Blechnum wattsii* and cladodes of the conifer *Phyllocladus asplenifolius* in wet forest in southern Tasmania. For a full description, see McCarthy & Kantvilas (2000b).

Trichothelium nanum Malcolm & Vězda, *Folia Geobot. Phytotax.* **30**, 95 (1995)
A common but very inconspicuous species in Tasmania, *T. nanum* is also known from eastern Queensland, Victoria and New Zealand. For a full description, see Malcolm & Vězda (1995a).

SELECTED SPECIMENS EXAMINED (n = 19; 11 localities; 3 host species)
•c. 1.5 km NW of Liapootah Power Station, 42°22'S, 146°30'E, alt. 360 m, *Kantvilas 304/90*, 4.viii.1990; •Flash Tier, near Seventeen Acre Creek, 42°36'S, 147°53'E, alt. 300 m, *Kantvilas 325/90*, 10.x.1990; Bun Hill, Forestier Peninsula, 42°58'S, 147°56'E, alt. 320 m, *A. Shapcott*, v.1991; •Bermuda Road, Scotts Divide, 43°04'S, 146°54'E, alt. 500 m, *Kantvilas 47/99*, 9.ii.1999; •Meetus Falls, 41°51'S, 147°53'E, alt. 510 m, *Kantvilas 193/99*, 16.v.1999.

Discussion

Species and Habitats

As an ecological group, foliicolous lichens tend to be a feature of relatively mild, moist climates and microhabitats. Their distribution in Tasmania reflects this trend, with the most species-rich and/or luxuriant assemblages of taxa occurring in the comparatively mild, eastern and south-eastern parts of the island. There they are found mainly in sheltered gullies containing relict rainforest vegetation, or wet-sclerophyll forest with some rainforest vascular taxa. Large tracts of cool-temperate rainforest, such as are found in north-western, western and south-western Tasmania, do not appear to support diverse communities of foliicolous lichens, although scattered, occasional species may occur locally within them. Thus the sites with the greatest number of species (all in eastern Tasmania) are Bun Hill on Forestier Peninsula (12 species), Meetus Falls (11 species) and the upper reaches of the Apsley River (10 species), both in the Eastern Tiers. All three sites are at altitudes under 600 m. Above that elevation, and up to 1300 m, diversity diminishes rapidly, and most sites with foliicolous lichens have no more than one or two species. At most foliicolous lichen sites, species distribution is typically very patchy. Frequently, most species may be confined to a particular individual tree, a side of a tree, or even to just a few limbs.

The richest hosts are *Atherosperma moschatum* (18 species) and *Blechnum wattsii* (14 species); together they account for more than 90% of records. Other phorophytes are the shrubs *Cenarrhenes nitida*, *Olearia argophylla*, *Richea pandanifolia* and *R. scoparia*, the climber *Parsonsia brownii*, the conifers *Athrotaxis cupressoides*, *Diselma archeri*, *Lagarostrobos franklinii*, *Microstrobos niphophilus* and *Phyllocladus aspleniifolius* and the ferns *Hymenophyllum* sp., *Microsorum diversifolium* and *Polystichum proliferum*. Significantly, despite having large leaves and occurring in seemingly ideal, moist, sheltered habitats, typical "Gondwanan" vascular plant genera, such as *Cenarrhenes*, *Agastachys*, *Anopterus*, *Richea*, *Orites* and *Telopea* either lack any foliicolous lichen flora or support occasional species only very rarely.

Foliicolous communities in Tasmania are usually dominated by some or all of a suite of seven species: *Badimiella serusiauxii*, *Porina subapplanata*, *Trichothelium nanum*, *Byssoloma subundulatum*, *Fellhanera endopurpurea*, *Arthonia cyanea* and *A. trilocularis*. With the exception of the two *Arthonia* species, all taxa are confined to south-eastern Australasia or the south-western Pacific. Virtually all the foliicolous species reported in this paper belong to this single ecological group. However, the two species of *Roccellinastrum*, being confined almost exclusively to the leaves of conifers and occurring mostly at alpine elevations, constitute an unrelated association.

Arthonia apteropteridis Kantvilas & Vězda, also known from Victoria, has frequently been included in inventories of foliicolous species, e.g. Farkas & Sipman (1997), on account of having been described from the fronds of the endemic Tasmanian fern *Sphaerocionium applanatum* (syn.: *Apteropteris applanata*) (Kantvilas & Vězda 1988). This lichen is actually most abundant on the bark of *Nothofagus cunninghamii*, and its occurrence on the fern fronds was restricted to dead tissue.

Biogeographical Affinities

Apart from a couple of essentially cosmopolitan and facultatively foliicolous taxa (*Byssoloma subdiscordans* and *Fellhanera bouteillei*), the foliicolous flora is almost equally divided between mainly tropical species and more or less exclusively southern-temperate species (Table 1). The tropical component, with pantropical and Paleotropical elements, includes species at the temperate limit of their ranges.

Only *Arthonia cyanea*, *A. trilocularis* and *Fellhanera endopurpurea* could be described as common in Tasmania; the rest are most abundant in especially mild and sheltered sites. In contrast, the southern-temperate component, comprising endemic, southern Australasian and southern pantemperate taxa, is dominant at most sites and at all elevations.

Table 1. Biogeographical elements among Tasmanian foliicolous lichens

Cosmopolitan	*Byssoloma subdiscordans*
	Fellhanera bouteillei
Pantropical	*Arthonia cyanea*
	A. trilocularis
	Aspidothelium cinerascens
	Byssoloma leucoblepharum
	Mazosia phyllosema
	Porina atrocoerulea
	Porina leptosperma
	Strigula nitidula
	Tapellaria phyllophila
Paleotropical/Western Pacific	*Bullatina microcarpa*
	Fellhanera endopurpurea
	Trichothelium javanicum
	T. nanum
Southern-Pantemperate	*Kantvilasia hians*
Southern Australasian	*Badimiella serusiauxii*
	Byssoloma subundulatum
	Enterographa bella
	Porina subapplanata
	Porinula setifera
Endemic	*"Porina blechnicola"*
	Roccellinastrum flavescens
	R. lagarostrobi
	Trichothelium meridionale

Key to the Species

1 Thallus subfruticose, byssoid-cottony 2
1: Thallus crustose, not byssoid-cottony 3

2 Thallus white, on *Lagarostrobos* ..... **Roccellinastrum lagarostrobi**
2: Thallus yellowish, on *Athrotaxis* ..... **Roccellinastrum flavescens**

3 Thallus sterile, with campylidia or sterile hairs 4
3: Thallus fertile, usually without campylidia or sterile hairs 7

4 Thallus lacking campylidia, whitish to pale grey, with white hairs ..... **Bullatina microcarpa**
4: Thallus with campylidia; hairs absent 5

5 Campylidia whitish to pale creamy yellow, with "horns" and other projections, ± unchanged when wet; conidiogenous layer exposed when dry; thallus nondescript ..... **Badimiella serusiauxii**
5: Campylidia at least partly dark grey to black, lacking "horns" and other projections, noticeably swollen when wet; conidiogenous layer enclosed when dry; thallus pale grey, well-defined 6

6 Campylidia flattened and scale-like when dry, cup-like when wet; conidia filiform, multiseptate ..... **Tapellaria phyllophila**
6: Campylidia erect with lateral flaps folded inwards when dry; flaps spreading when wet; conidia obovoid, simple ..... **Kantvilasia hians**

7 Ascomata arthonioid or lirellate 8
7: Ascomata perithecioid or apothecioid 10

8 Ascomata lirellate, elongate; excipulum thick, yellowish brown; disc narrow, dark brown; ascospores colourless, fusiform, 7-septate ..... **Enterographa bella**
8: Ascomata arthonioid, irregularly rounded; excipulum absent; ascospores 2–3-septate 9

9 Ascomata medium to dark bluish grey; ascospores hyaline ... **Arthonia cyanea**
9: Ascomata dark green, olive-brown or blackish; ascospores brown ..... **Arthonia trilocularis**

10 Ascomata perithecia or perithecium-like 11
10: Ascomata apothecioid 21

11 Ascomata hyaline, cream-coloured, yellowish brown, orange- or red-brown ... 12
11: Ascomata black 17

12 Ascomata immersed, crater-like; margins dark; base pale; hamathecium ± simple; ascospores fusiform, 3-septate ..... **Mazosia phyllosema**
12: Ascomata true perithecia 13

13 Perithecia green, with a crown of minute concolorous spines or hairs, to 0.2 mm diam.; thallus minute, rounded, green; ascus apex thick-walled; paraphyses simple; ascospores 1-septate ..... **Porinula setifera**
13: Perithecia lacking a crown of spines or hairs; ascospores 3- or more septate.. 14

14 Ascospores muriform; perithecia hyaline to cream-coloured, hemispherical to subglobose, with a swollen apex or spreading apical disc ..... **Aspidothelium cinerascens**
14: Ascospores with transverse septa only 15

15 Ascospores 7-septate; perithecia (0.25–)0.5(–0.75) mm diam., applanate to convex ..... **Porina subapplanata**
15: Ascospores 3-septate; perithecia 0.13–0.26 mm diam., hemispherical to subglobose, concolorous, pale orange-brown or dark reddish brown 16

16 Perithecia medium to dark orange-red; base attenuated; ascospores 14–24 × 3–4.5 µm ..... **Porina leptosperma**
16: Perithecia concolorous with the thallus to pale orange-brown; base spreading slightly, not attenuated; ascospores 18–30 × 4.5–6 µm .... **"Porina blechnicola"**

17 Perithecia with a crown of whitish to black subapical setae 18
17: Perithecia lacking setae 20

18 Ascospores 7-septate ..... **Trichothelium meridionale**
18: Ascospores 3-septate 19

19 Perithecia 0.08–0.16(–0.2) mm diam.; setae usually soft, decurved and uniformly whitish ..... **Trichothelium nanum**
19: Perithecia 0.14–0.25(–0.3) mm diam.; setae usually stiff, horizontal or oblique and black with whitish tips ..... **Trichothelium javanicum**

20 Perithecia convex to conical, 0.35–0.65 mm diam.; ascospores 1-septate; cells often separating in the asci ..... **Strigula nitidula**
20: Perithecia globose, 0.15–0.25 mm diam.; ascospores 7-septate; cells not separating in the asci ..... **Porina atrocoerulea**

21 Ascospores muriform 22
21: Ascospores with transverse septa only 24

22 Thallus pale grey, with white hairs ..... **Bullatina microcarpa**
22: Thallus lacking white hairs 23

23 Apothecia innate, 0.19–0.32 mm diam., blackish; exciple pale, hyphal, rudimentary; ascospores 1 per ascus, 37–68 × 16–28 µm; conidia obovoid, simple ..... **Kantvilasia hians**
23: Apothecia sessile, 0.3–0.8 mm diam., blackish; exciple dark, parenchymatous, well developed; ascospores 4 per ascus, 50–105 × 9–17 µm; conidia filiform, multiseptate ..... **Tapellaria phyllophila**

24 Ascospores 1-septate, 14–18 × 5–6 µm; paraphyses anastomosing; thallus pale; apothecia very pale, with a very thin margin and a ± plane to slightly convex disc ..... **Fellhanera bouteillei**
24: Ascospores with 3 or more septa 25

25 Apothecial margin byssoid (sometimes faint, but distinct in section) 26
25: Apothecial margin not byssoid 28

26 Apothecia margin faintly byssoid; hyphae not spreading over adjacent thallus; disc pale brown to blackish; ascospores 3(–5)-septate ..... **Byssoloma subundulatum**
26: Apothecia margin distinctly byssoid; hyphae spreading over adjacent thallus; ascospores 3-septate 27

27 Apothecial disc pale to medium brown ..... **Byssoloma leucoblepharum**
27: Apothecial disc jet-black ..... **Byssoloma subdiscordans**

28 Ascospores 11–15 × 3–4 µm; apothecia sessile, pale to rather dark grey-brown to greenish brown; hypothecium dark; paraphyses anastomosing; campylidia absent ..... **Fellhanera endopurpurea**
28: Ascospores 14–22 × 4–6 µm; apothecia sessile, pale brown to pale yellowish brown; hypothecium pale greenish; paraphyses simple; campylidia always present ..... **Badimiella serusiauxii**

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Additional lichen records from Australia 46. Parmeliaceae

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Hypotrachyna addita, H. adjuncta, H. orientalis, Parmotrema lobulascens, and *Xanthoparmelia barthlottii* are reported as new to Australia. In addition, new state or territory records are listed for 15 other species.

1. *Bulbothrix tabacina* (Sm.) Hale, *Phytologia* **28**, 481 (1974)

This pantropical species is known from New South Wales and Queensland, but has not been recorded previously from Norfolk Island (Elix 1994). It is characterized by the broad, pale grey lobes, bulbate cilia, cylindrical isidia, a black lower surface, and salazinic acid in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Norfolk Island: •Picnic Area, end of Martin's Road, 29°03'S, 167°59'E, 80 m, on trunk of *Elaeodendron* in open *Araucaria* woodland, *J.A. Elix 18164 & H. Streimann,* 1 Dec. 1984 (CANB).

2. *Canoparmelia owariensis* (Asahina) Elix, *Mycotaxon* **47**, 127 (1993)

This paleotropical species is known from Africa, China, Japan, Thailand, and in Australia from Queensland (Elix 1994), but has not been recorded previously from the Northern Territory. It is characterized by the adnate to tightly adnate thallus, whitish grey lobes, a pustulate-isidiate upper surface, a black lower surface, and divaricatic acid in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Northern Territory: •Umbrawarra Gorge, 22 km SW of Pine Creek, 13°38'S, 131°42'E, 210 m, on sandstone rocks in steep-sided rocky gorge, *J.A. Elix 28074 & H. Streimann,* 17 July 1991 (CANB).

3. *Hypotrachyna addita* (Hale) Hale, *Phytologia* **28**, 340 (1974)

This species has previously been reported from the Philippines, Malaysia (Hale 1972), and Papua New Guinea (Kurokawa 1979). It is characterized by the sublinear to subirregular lobes, the mostly simple or occasionally ± lobulate isidia, and by the presence of 4-*O*-demethylbarbatic, barbatic, and echinocarpic acids in the medulla. A detailed description follows.

Thallus moderately adnate to adnate, 2–5 cm wide. Lobes contiguous, becoming crowded and subimbricate, sublinear to subirregular, subdichotomously to irregularly branched, 1–3(–4) mm wide, often sinuous in lobe axils, apices subtruncate; margins entire, black, particularly in lobe axils, sometimes becoming irregularly incised. Upper surface whitish mineral grey, emaculate or rarely ± faintly maculate, continuous, smooth or becoming finely rugulose with age, isidiate; isidia sparsely to moderately dense, laminal, mostly cylindrical or occasionally irregularly inflated, dark-tipped, mostly simple, rarely branched or becoming ± lobulate. Medulla white. Lower surface black with a narrow (1 mm wide) brown marginal zone, shiny, mostly smooth or sometimes becoming finely rugulose, densely rhizinate; rhizines densely dichotomously branched, sometimes extending along the lobe margins, often projecting beyond lobes. Apothecia and pycnidia not seen.

Chemistry: Cortex K+ yellow; medulla K–, C–, KC+ orange, P–; containing atranorin, chloroatranorin, 4-*O*-demethylbarbatic acid (major), barbatic acid (minor), and echinocarpic acid (minor/trace).

SPECIMEN EXAMINED

Queensland: •Main Coast Range, Windmill Creek, 14 km NNW of Mt Molloy,

16°34'S, 145°17'E, 1000 m, on fallen branch in rainforest, *J.A. Elix 16983 & H. Streimann,* 30 June 1984 (CANB).

4. *Hypotrachyna adjuncta* (Hale) Hale, *Phytologia* **28**: 340 (1974)

This species was previously known from India, the Philippines, Malaysia, Taiwan and Japan (Hale 1972, Kurokawa & Lai 2001). It is characterised by the sublinear to subirregular lobes, the erumpent pustules, and by the barbatic acid complex with additional echinocarpic acid in the medulla. A detailed description follows.

Thallus moderately adnate to adnate, 5–10 cm wide. Lobes contiguous, becoming crowded and imbricate, sublinear to subirregular, subirregularly branched, 1–3(–4) mm wide, apices subtruncate to subrotund; margins entire or ± small-incised, rarely crenate. Upper surface ashen grey, ± shiny, continuous, smooth or finely rugulose, or faintly maculate, pustulate; pustules subterminal and subcapitate or occasionally laminal, mostly erumpent, eventually eroding and becoming coarsely granular sorediate, exposing black lower cortex. Medulla white. Lower surface black, shiny, with a brown marginal zone, moderately to densely rhizinate; rhizines dichotomously branched, often projecting beyond lobe margin or growing horizontally from margin. Apothecia and pycnidia not seen.

Chemistry: Cortex K+ yellow; medulla K–, C+ orange, KC+ deep orange, P–; containing atranorin, chloroatranorin, barbatic acid (major), 4-*O*-demethylbarbatic acid (secondary major), obtusatic acid (trace), norobtusatic acid (trace), ± echinocarpic acid (minor/trace), conechinocarpic acid (trace), ± squamatic acid (faint trace), and ± 3α-hydroxybarbatic acid (faint trace).

SPECIMENS EXAMINED

Queensland. •Gillies Highway, 17 km SW of Gordonvale, 17'13'S, 145'43'E, 680 m, on *Alphitonia* along rainforest margin, *J.A. Elix 16735 & H. Streimann,* 28 June 1984 (CANB); •Walter Hill Range, 26 km SE of Ravenshoe, 17°46'S, 145°41'E, 800 m, on mossy truck on felled tree in rainforest, *J.A. Elix 17037, 17038 & H. Streimann,* 2 July 1984 (CANB).

5. *Hypotrachyna orientalis* (Hale) Hale, *Phytologia* **28**: 341 (1974)

This species is characterized by the sublinear, subimbricate lobes, the cylindrical, simple or, rarely, branched isidia, and by the presence of barbatic and 4-*O*-demethylbarbatic acids as major medullary substances. Kurokawa (1979) considered *H. orientalis* to be a chemical variant of *H. imbricatula,* with *H. orientalis* containing only barbatic and 4-*O*-demethylbarbatic acids in the medulla, whereas *H. imbricatula* also contains appreciable amounts of obtusatic and norobtusatic acids. Recently the accessory depside, norbaeomycesic acid, has also been described for *H. orientalis* (Elix *et al.* 2000a). However, Krog & Swinscow (1979) considered these two taxa to be distinct species, and we concur with them. Indeed, *Hypotrachyna imbricatula* can be distinguished from *H. orientalis* on both morphological and chemical grounds. The former species tends to form more robust, coriaceous thalli, which are distinctly white-maculate, whereas *H. orientalis* is more fragile and membranaceous in appearance, and lacks maculae. *Hypotrachyna orientalis* has previously been reported from Nepal, Thailand, Philippines, Malaysia (Hale 1972), Papua New Guinea (Kashiwadani 1975) and East Africa (Krog & Swinscow 1979). A detailed description follows.

Thallus moderately adnate to adnate, 5–12 cm wide. Lobes contiguous or becoming subimbricate, sublinear, subdichotomously to irregularly branched, 1–4(–5) mm wide, apices subtruncate; margins entire, sometimes irregularly incised or ± dentate, lobe axils often sinuous. Upper surface pale grey-green, emaculate or rarely weakly white-maculate, continuous, smooth, becoming finely rugulose with age, isidiate; isidia moderately dense to dense, laminal, cylindrical, slender, simple or rarely branched, often dark-tipped. Medulla white. Lower surface black, shiny, brownish towards margins, moderately to densely rhizinate; rhizines densely dichotomously branched, black, shiny, sometimes growing horizontally from lobe margins. Apothecia and pycnidia not seen, but the former have been previously reported as rare; ascospores 10–12 × 4–5 µm (Krog & Swinscow 1979).

Chemistry: Cortex K+ yellow; medulla K–, C–, KC+ orange, P–; containing atranorin, chloroatranorin, barbatic acid (major), 4-*O*-demethylbarbatic acid (secondary major), ± norbaeomycesic acid (trace), ± obtusatic acid (trace), and ± norobtusatic acid (trace).

SPECIMENS EXAMINED

Queensland. •1 km S of Maalan, 11 km E of Ravenshoe, 17°36'S, 145°38'E, 980 m, on remnant *Alphitonia* tree along roadside, *J.A. Elix 17123A & H. Streimann,* 2 July 1984 (CANB); •Mt Windsor, *ca.* 5 km W of new Forestry Camp, NW of Mossman, 1100 m, on bark at logging head in rainforest, *M.E. Hale 64070,* 11 July 1983 (US); •Culpa logging area, 13 km from Koombooloomba road turnoff, SE of Tully Falls, 800 m, on bark at logging head in rainforest, *M.E. Hale 64092,* 21 July 1983 (US); •Davies Creek road, 17 km S of Kennedy Highway, S of Davies Creek Falls National Park, E of Mareeba, 600 m, on bark, logging area in rainforest, *M.E. Hale 64124,* 7 July 1983 (US); •Mt Hypipamee National Park, area below crater, S of Atherton, 900 m, on bark in open rainforest, *M.E. Hale 65919,* 17 July 1983 (US).

6. *Hypotrachyna revoluta* (Flörke) Hale, *Smithsonian Contrib. Bot.* **25**, 60 (1975)

This cosmopolitan species is known from New South Wales, Australian Capital Territory, Victoria, South Australia, and Tasmania, but has not been recorded previously from Western Australia (Elix 1994). It is characterised by the short, subascending, revolute lobes with extensive subapical soredia and gyrophoric acid in the medulla. A detailed description is given in Elix (1994).

SPECIMENS EXAMINED

Western Australia: •Porongurups Range, Porongurups National Park, slopes of Angwin Peak, 19 km ESE of Mt Barker, 34°40'S, 117°51'E, 360 m, on *Banksia* and *Leucopogon* twigs in heath, *J.A. Elix 41359, 41362, H.T. Lumbsch & H. Streimann,* 16 Sep. 1994 (CANB).

7. *Neofuscelia parviloba* (Essl.) Essl., *Mycotaxon* **7**, 51 (1978)

This endemic Australian species has been collected previously in Queensland, New South Wales, Australian Capital Territory, Victoria and Tasmania (Elix 1994). It is characterised by the diminutive, subcrustose thallus, the pale lower surface, absence of isidia and presence of fumarprotocetraric and protocetraric acids in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Western Australia: •South Coast Highway, 30 km W of Denmark, 34°57'S, 117°01'E, 30 m, on granite rocks in heathy, dry sclerophyll forest, *J.A. Elix 41267A, H.T. Lumbsch & H. Streimann,* 15 Sep. 1994 (CANB).

8. Neofuscelia squamariatella Elix, *Mycotaxon* **71**, 448 (1999)

This Australasian species was known previously from exposed rocks in upland areas of the Australian Capital Territory, South Australia, and the South Island of New Zealand (Elix 1999). It is characterised by the diminutive, subcrustose thallus, the pale lower surface, the absence of isidia, and the presence of norstictic and connorstictic acids in the medulla. A detailed description is given in Elix (1999).

SPECIMENS EXAMINED

Western Australia: •Yilliminning Rock, 18 km NE of Narrogin, 32°57'S, 117°22'E, on large, exposed granite outcrop surrounded by dry sclerophyll forest, *J.A. Elix 41069, 41075, H.T. Lumbsch & H. Streimann,* 12 Sep. 1994 (CANB).

9. *Parmotrema lobulascens* (Steiner) Hale, *Phytologia* **28**, 337 (1974)

This species was previously known from Africa and Asia (Krog & Swinscow 1981). It differs from the morphologically and chemically similar species, *Parmotrema poolii* (Dodge) Krog & Swinscow, in having a distinctly maculate upper surface of the lobes, secondary lobules on the lobe margins, accessory gyrophoric acid in the medulla, and filiform conidia (*P. poolii* is emaculate, elobulate, lacks gyrophoric acid and has sublageniform conidia 7–8 × 1 µm). A detailed description follows.

Thallus adnate, coriaceous, to 16 cm wide. Lobes imbricate, subirregular, 5–15 mm wide; margins crenate or irregularly incised-dentate, ascending or revolute; cilia sparse to moderately dense, 0.2–5.0 mm long; laciniae common along the lobe margins. Upper surface pale grey to grey-green, flat, distinctly maculate, irregularly cracked, ± with black discoloured patches, isidia absent; soralia linear on ascending lobe margins or submarginal, pustular, and punctiform to confluent on revolute lobes. Medulla white. Lower surface black, with a brown erhizinate marginal zone; rhizines unevenly distributed, simple, slender, to 1 mm long. Apothecia rare, submarginal, stipitate to substipitate, 3–10 mm wide; disc perforate or imperforate, often radially split; thalline exciple strongly rugose, becoming sorediate, thalline margin crenate to lobulate. Ascospores ellipsoid, 20–28 × 10–16 µm. Pycnidia rare, immersed. Conidia filiform, 12–18 × 1 µm.

Chemistry: cortex K+ yellow; medulla K–, C–, KC+ red, P–; containing atranorin, chloroatranorin, alectoronic acid (major), ± α-collatolic acid (major/minor), and ± gyrophoric acid (minor/trace).

SPECIMEN EXAMINED

Queensland: •Ingham–Kangaroo Hills Road, 36 km SW of Ingham, 18°49'S, 145°53'E, 650 m, on granite rocks in dry sclerophyll forest, *J.A. Elix 20395 & H. Streimann,* 19 June 1986 (CANB).

10. *Rimelia cetrata* (Ach.) Hale & A. Fletcher, *Bryologist* **93**, 26 (1990)

This pantemperate-pansubtropical species from North and South America, Hawaii, New Zealand and southern Africa (Hale & Fletcher 1990, Malcolm & Galloway 1997) is rare in Australia, previously recorded only from Tasmania (Elix 1994). It is characterized by the reticulately cracked upper surface, the prominent cilia, the absence of soredia and isidia, the dense simple to squarrose branched rhizines and the medullary salazinic acid. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Western Australia: •Mt Chudalup, 17 km SSE of Northcliffe, 34°46'S, 116°05'E, 185 m, on large, exposed granite outcrop with scattered shrubs, *J.A. Elix 41161, H.T. Lumbsch & H. Streimann,* 14 Sep. 1994 (CANB).

11. *Rimelia clavulifera* (Räsänen) Kurok., *Journal of Japanese Botany* **66**, 158 (1991)

This widespread, temperate to tropical species is known from East Asia, Papua New Guinea, and Tahiti (Kurokawa 1979, Kurokawa & Lai 2001), and has been reported previously from Victoria and Queensland (Filson 1987). It is distinguished from *R. reticulata* (Tayl.) Hale & A. Fletcher by the presence of a white mottled zone near the margin of the lower surface of the lobes, especially when soralia are formed on the upper surface.

SPECIMENS EXAMINED

New South Wales: •Currowan State Forest, 6 km NW of Nelligen, 35°36'S, 150°05'E, 120 m, on *Ficus* sp. in wet sclerophyll forest, *J.A. Elix 3609,* 7 July 1977 (CANB). *Australian Capital Territory:* •Uriarra Crossing, 15 km W of Canberra, 35°15'S, 148°57'E, 520 m, on *Leptospermum* in thicket, *J.A. Elix 743,* 22 Apr. 1975 (CANB). *Norfolk Island:* •Rocky Point Reserve, 29°03'S, 167°55'E, 60 m, on rocks in mixed *Araucaria* and exotic woodland, *J.A. Elix 18191, 18218 & H. Streimann,* 2 Dec. 1984 (CANB); •just S of Captain Cook Memorial, Duncombe Bay, 29'00'S, 167'56.5'E, 100 m, on trunk of *Elaeodendron* in regrowth forest, *J.A. Elix 18371 & H. Streimann,* 3 Dec. 1984 (CANB); •Mt Pitt Reserve, King Fern Valley, 29°01'S, 167°56'E, 260 m, on *Cyathea* in mixed subtropical rainforest, *J.A. Elix 18665 & H. Streimann,* 7 Dec. 1984 (CANB); •Anson Bay Road, 29°01'S, 167°55.5'E, 50 m, on trunk of *Lagunaria patersonii* in open *Araucaria* woodland, *J.A. Elix 18778 & H. Streimann,* 9 Dec. 1984 (CANB).

12. *Xanthoparmelia austroalpina* Elix, *Mycotaxon* **56**, 238 (1995)

This endemic alpine-subalpine species was known previously from New South Wales and Victoria. It is characterized by the adnate thallus, the brown lower surface, the lack of isidia and production of constipatic and protoconstipatic acids in the medulla. A detailed description is given in Elix (1995).

SPECIMEN EXAMINED

Australian Capital Territory: •Brindabella Range, summit of Mt Franklin, 45 km WSW of Canberra, 35°29'S, 148°47'E, 1644 m, on exposed schistose stones in subalpine grassland, *J.A. Elix 30348,* 3 Nov. 1999 (CANB).

13. *Xanthoparmelia barthlottii* Elix & U. Becker, *Mycotaxon* **71**, 3 (1999)

This rare species was previously known only from Zimbabwe (Elix *et al.* 1999). It is characterized by the small foliose to subcrustose, tightly adnate thallus, the globose isidia, pale lower surface and the production of salazinic acid and consalazinic acid in the medulla. A detailed description follows.

Thallus small foliose to subcrustose, tightly adnate, to 2–3 cm wide. Lobes imbricate or not, flat, sublinear to irregular, irregularly branched, 0.6–1.0 mm wide, older lobes ± irregularly fractured and areolate. Upper surface yellow-green, shiny at least towards the apices, emaculate, lacking soredia but sparsely to moderately isidiate, the isidia globose to subcylindrical, ± inflated, simple, apices pale, syncorticate. Medulla white. Lower surface shiny, pale brown to brown, rhizines sparse to moderately dense, concolorous. Apothecia and pycnidia not seen.

Chemistry. Cortex K–; medulla K+ pale yellow then red, C–, KC–, P+ orange-red containing usnic acid, salazinic acid (major), and consalazinic acid (minor).

SPECIMEN EXAMINED

Queensland: •Plover Plain, Mt Fox to Kennedy Development Road, 45 km N of Greenvale, 18°34'S, 144°55'E, 600 m, on semi-exposed rock outcrop in *Leptospermum* dominated seasonal swampy area, *H. Streimann 46827b,* 19 Dec. 1990 (CANB).

14. *Xanthoparmelia biconfinens* Elix & T.H. Nash, *Mycotaxon* **29**, 471 (1987)

In Australia this rare species is known from alpine areas and cool temperate forests of southern New South Wales and Victoria (Elix 1994). It is characterized by the tightly adnate thallus, the barely imbricate, linear-elongate, dichotomously branched lobes, the black lower surface, and the production of stictic acid and satellite compounds in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED

Australian Capital Territory: •Brindabella Range, summit of Mt Aggie, 43 km WSW of Canberra, 35°28'S, 148°46'E, 1490 m, on exposed schistose stones in subalpine grassland, *J.A. Elix 19817 & G. Rambold,* 27 Jan. 1986 (CANB).

15. *Xanthoparmelia darlingensis* Elix & J. Johnst., *Mycotaxon* **29**, 363 (1987)

This very rare endemic species was previously only known from the type locality in Western Australia (Elix 1994). It is characterized by the very tightly adnate, subcrustose thallus, the linear-elongate, widely separate, dichotomously branched lobes, the black lower surface, and the presence of both barbatic acid and stictic acid (and their satellite compounds) in the medulla. A detailed description is given

in Elix (1994).

SPECIMENS EXAMINED
South Australia: •Eyre Peninsula, 13 km NE of Cleve, 33°39'S, 136°37'E, 380 m, on schistose rocks in dense *Leptospermum*-dominated regrowth, *J.A. Elix 41801, 41805*, 23 Sep. 1994 (CANB).

16. *Xanthoparmelia immutata* Elix & J. Johnst., *Bulletin of the British Museum (Natural History), Botany* **15**, 266 (1986)
This rare endemic species from inland Australia was previously known from Northern Territory, South Australia and Queensland (Elix 1994). It is characterized by the narrow, very tightly adnate lobes with a pale lower surface, globose, non-erumpent isidia, and the presence of constipatic acid, protoconstipatic acid and scabrosin derivatives in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
Western Australia: •Serpent Glen, Carnarvon Range, just N of Wiluna, 25°39'S, 120°16'E, 185 m, on Wonyulgunna sandstone, *Eric McCrum s.n.*, 25 Aug. 1999 (CANB).

17. *Xanthoparmelia microphyllizans* Elix, *Mycotaxon* **74**, 500 (2000)
This rare endemic species was previously known from Deal Island in Bass Strait (Elix *et al.* 2000b). It is characterized by the tightly adnate, foliose thallus, the densely imbricate, microphylline laciniae, the pale lower surface, the absence of isidia, and the presence of loxodin and norlobaridone in the medulla. A detailed description is given in Elix *et al.* (2000b).

SPECIMEN EXAMINED
South Australia: •Mt Lofty Ranges, 4 km W of Carey Gully along the Forest Range Road 34°58'S, 138°46'E, 456 m, on sandstone rocks in dry sclerophyll forest, *J.A. Elix 2821*, 21 Dec. 1976 (CANB).

18. *Xanthoparmelia nigrocephala* Kurok., *Annals of Tsukuba Botanical Garden* **8**, 24 (1989)
This apparently rare alpine-subalpine species was previously known from New South Wales and the Australian Capital Territory (Elix 1994, 1997). It is characterized by irregular, broad lobes (1–5 mm wide), with dense, black-tipped, branched isidia, a pale lower surface, and medullary salazinic acid. A detailed description is given in Elix (1994).

SPECIMENS EXAMINED
Victoria: •Mt Nelse, Alpine National Park, 19 km SE of Mt Beauty, 36°51'S, 147°20'E, 1880 m, on exposed granite rocks in alpine grassland, *J.A. Elix 40651 & H. Streimann*, 19 Feb. 1994 (CANB); •track to Mt Cope, Alpine National Park, 23 km SSE of Mt Beauty, 36°56'S, 147°17'E, 1750 m, on exposed granite rocks in *Eucalyptus pauciflora* woodland, *J.A. Elix 40798 & H. Streimann*, 19 Feb. 1994 (CANB).

19. *Xanthoparmelia nonreagens* Elix & J. Johnst., *Mycotaxon* **29**, 365 (1987)
This scattered endemic species was known previously from Queensland and South Australia (Elix 1994). It is characterized by the very tightly adnate, small-foliose to subcrustose thallus, narrow subirregular to linear-elongate lobes, pale lower surface, cylindrical isidia, and by the production of scabrosins in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
New South Wales: •Port Macquarie, 38°03'S, 140°42'E, 3 m, on rocks along the foreshore, *J.A. Elix 1074*, 19 Aug. 1975 (CANB).

20. *Xanthoparmelia rubrireagens* (Gyeln.) Hale, *Phytologia* **28**, 488 (1974)
This Australasian species is known from Queensland, New South Wales, Australian Capital Territory, Victoria, Tasmania, and the South Island of New Zealand, but has not been recorded previously from South Australia (Elix 1994). It is characterized by the narrow, linear-elongate lobes which are di- or trichotomously branched and often ascending at the apices, a black very sparsely rhizinate, rugose lower surface and salazinic acid in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
South Australia: •Mt Lofty Ranges, Borthwick Road, 6.5 km E of Tungkillo, 34°49'S, 139°08'E, 470 m, on granite rocks in pasture, *J.A. Elix 9468*, 30 Oct. 1981 (CANB).

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Additional lichen records from Oceania 7. Parmeliaceae from Fiji

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For the most part, the lichens of the Fiji Islands remain poorly known. A recent survey of the lichenological literature of the smaller Pacific islands listed 118 taxa reported for Fiji (Elix & McCarthy 1998), and others have been reported since (McCarthy & Elix 2000). However, the true diversity of the flora is likely to be significantly greater than this, given the lack of systematic field investigations, the great age of these islands (they are remnants of Gondwana), their size and elevation, and the broad range of habitats available. In this paper, I report the first Fijian records of eleven taxa in the Parmeliaceae.

1. *Bulbothrix goebelii* (Zenker) Hale, *Smithsonian Contr. Bot.* **32**, 14 (1976).

This species was previously known from North, Central and South America, Africa, Thailand, Indonesia, the Philippines, Malaysia, Papua New Guinea, Australia, Vanuatu (Elix 1994, Hale 1976a) and Rarotonga (Louwhoff & Elix 2000). It is characterized by the presence of isidia, dense bulbate cilia, branched rhizines, and gyrophoric acid in the medulla. A detailed description is given in Elix (1994).

SPECIMENS EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 13 km E of Vanturu Dam turnoff, on tree trunk in regrowth forest along roadside, *J.A. Elix 15212*, 27 July 1983 (CANB). •Coral Coast, Tagaque Village, 20 km E of Sigatoka, on coconut palm along foreshore, *J.A. Elix 15337*, 29 July 1983 (CANB).

2. *Bulbothrix isidiza* (Nyl.) Hale, *Phytologia* **28**, 480 (1974).

This pantropical species is particularly common in open secondary forests in Africa, Central and South America, Japan, Hawaii, India, Malaysia, Indonesia, Papua New Guinea, and Australia (Elix 1994, Hale 1976a) and Rarotonga (Louwhoff & Elix 2000). The broad lobes, dense bulbate cilia, isidiate upper surface, pale lower surface, and salazinic acid in the medulla characterize this species. A detailed description is given in Elix (1994).

SPECIMENS EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3.6 km W of Vanturu Dam turnoff, on tree trunk in regrowth forest along roadside, *J.A. Elix 15119*, *15139*, 26 July 1983 (CANB). •Nasori Highlands, Nadi-Sigatoka Road, 13 km E of Vanturu Dam turnoff, on tree trunk in regrowth forest along roadside, *J.A. Elix 15206*, *15238*, 27 July 1983 (CANB).

3. *Hypotrachyna exsecta* (Taylor) Hale, *Phytologia* **28**, 341 (1974).

This species is known from East Asia, Southeast Asia, Papua New Guinea, and Australia (Elix 1994). It is characterised by pustules which become erumpent, eroded and granular-sorediate with age, and barbatic acid in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3 km W of Vanturu Dam turnoff, on *Dacrydium* in regrowth forest on roadside, *J.A. Elix 15276*, 27 July 1983 (CANB).

4. *Hypotrachyna immaculata* (Kurok.) Hale, *Smithsonian Contr. Bot.* **25**, 41 (1975).

This temperate-tropical species has been reported from Africa, South America, and Australia (Elix 1994, Hale 1975). It is characterized by the capitate soralia, the UV– upper cortex (no lichexanthone present), and the lividic acid complex in the medulla. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 13 km E of Vanturu Dam turnoff, on tree trunk in regrowth forest along roadside, *J.A. Elix 15205*, 26 July 1983 (CANB).

5. *Hypotrachyna majoris* (Vain.) Hale, *Phytologia* **28**: 341 (1974).

This species is characterised by the adnate thallus, the distinctly farinose-sorediate, revolute or hooded lobe apices, and by the presence of salazinic acid, zeorin, and triterpenes in the medulla. *Hypotrachyna majoris* appears to be an eciliate morphotype of ***Hypotrachyna radiculata* (Kurok.) Elix, comb. nov.** [Basionym: *Parmelia radiculata* Kurok., *Studies Crypt. Papua New Guinea* 139 (1979)], as both species have ± capitate, terminal or subterminal soralia and identical chemistry. *Hypotrachyna majoris* was previously known from Madagascar, Nepal, Taiwan (Kashiwadani 1975, Kurokawa & Lai 2001), and New Guinea (Kurokawa 1979, 1986). A detailed description follows.

Thallus moderately adnate, 3–8 cm wide. Lobes subcontiguous, becoming crowded or ± imbricate, subirregular, irregularly branched, often ascending along margins, 1–4 mm wide, subrotund at apices, involute behind lobe tips, lobe tips becoming hooded; margins entire or sometimes with small incisions. Upper surface pale grey-green, continuous, smooth or finely rugulose, emaculate, sorediate; soralia subterminal on hooded or reflexed lobe apices or, less commonly, spreading laminally, subcapitate or occasionally appearing labriform; soredia farinose. Medulla white. Lower surface black, becoming brown towards margins, shiny, smooth or ± rugulose, moderately rhizinate; rhizines moderately dichotomously or sometimes squarrosely branched, not projecting beyond lobe margins. Apothecia and pycnidia not seen.

Chemistry: Cortex K+ yellow; medulla K+ yellow turning red, C–, P+ orange; containing atranorin, chloroatranorin, salazinic acid (major), consalazinic acid (minor), zeorin (minor), 6α-acetoxyhopane-22-ol (minor), 6α-acetoxyhopane-16β,22-diol (trace), 16β-acetoxyhopane 6α,22-diol (trace), and ± protocetraric acid (trace).

SPECIMEN EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3 km W of Vanturu Dam turnoff, on *Dacrydium* in regrowth forest along roadside, *J.A. Elix 15275*, 27 July 1983 (CANB).

6. *Hypotrachyna neodigitata* Kurok. & Moon, *Bull. Bot. Gard. Toyama* **5**, 18 (2000).

This species was previously known from the Philippines and Papua New Guinea (Kurokawa & Moon 2000). It is characterized by the presence of lobulae and of the barbatic acid chemosyndrome in the medulla. A detailed description follows.

Thallus adnate, fragile, to 5 cm wide. Lobes imbricate, sublinear-elongate, subirregularly branched, 1–3 mm wide. Upper surface pale grey, flat, emaculate, smooth, ± glossy; cortex fragile; becoming densely lobulate on the surface and along the margins, lobules dichotomously branched, often ciliate, less than 1 mm wide. Medulla white. Lower surface black; rhizines dense, forming a mat on the lower surface and along the margins, richly dichotomously branched, up to 0.5 mm long. Apothecia and pycnidia not seen.

Chemistry: cortex K+ yellow, UV–; medulla K–, C–, KC+ orange, P–; containing atranorin (minor), chloroatranorin (minor), barbatic acid (major), obtusatic acid (minor), 4-*O*-demethylbarbatic acid (minor), and norobtusatic acid (minor).

SPECIMEN EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3 km W of Vanturu Dam turnoff, on *Dacrydium* in regrowth forest on roadside, *J.A. Elix 15255*, 27 July 1983 (CANB).

7. *Hypotrachyna osseoalba* (Vain.) Y.S. Park & Hale, *Taxon* **38**, 88 (1989).

In Australasia this common cosmopolitan, temperate to tropical species is known from Papua New Guinea, Australia, and New Zealand (Elix 1994, Malcolm & Galloway 1997). It is characterized by the laminal, pustular soredia and cortical lichexanthone (yellow under UV light). A detailed description is given in Elix (1994).

SPECIMENS EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3.6 km W of Vanturu Dam turnoff, on tree trunk in regrowth forest along roadside, *J.A. Elix 15137*, 26 July 1983 (CANB); •Nadi-Sigatoka Road, 3 km W of Vanturu Dam turnoff, on *Dacrydium* in regrowth forest along roadside, *J.A. Elix 15287*, 27 July 1983 (CANB).

8. *Myelochroa aurulenta* (Tuck.) Elix & Hale, *Mycotaxon* **29**, 240 (1987).

This pantemperate and pantropical species occurs on all continents except Europe (Elix 1994, Hale 1976b). It is characterized by the presence of pustulate soredia, a medulla which is yellow-orange in part, particularly below the soralia, the presence of secalonic acid A, leucotylic acid and zeorin in the medulla, and the sparingly ciliate lobes. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 4 km E of Vanturu Dam turnoff, on tree in regrowth forest along roadside, *J.A. Elix 15176*, 26 July 1983 (CANB).

9. *Parmotrema gardneri* (C.W. Dodge) Sérus., *Bryologist* **87**, 5 (1984).

This pantropical species is also known from Africa, South America, Australia, and Papua New Guinea (Elix 1994, Krog & Swinscow 1981). It is characterized by the loosely adnate, coriaceous thallus, the presence of marginal soralia, protocetraric acid in the medulla, and the eciliate or very sparingly ciliate lobes. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3 km W of Vanturu Dam turnoff, on *Dacrydium* in regrowth forest on roadside, *J.A. Elix 15280*, 27 July 1983 (CANB).

10. *Parmotrema saccatilobum* (Taylor) Hale, *Phytologia* **28**, 339 (1974).

This species is also known from India, East and Southeast Asia, Australia, Papua New Guinea, and many Pacific Islands (Elix 1994; Elix & McCarthy 1998; Hale 1965; Louwhoff & Elix 1999, 2000). It is characterized by the loosely adnate, coriaceous thallus, the presence of cylindrical isidia, protocetraric acid in the medulla, and the eciliate, broadly convoluted lobes. A detailed description is given in Elix (1994).

SPECIMEN EXAMINED
Viti Levu: •Coral Coast, Tagaque Village, 20 km E of Sigatoka, on coconut palm along foreshore, *J.A. Elix 15389*, 31 July 1983 (CANB).

11. *Rimelia clavulifera* (Räsänen) Kurok., *Journal of Japanese Botany* **66**, 158 (1991).

This widespread, temperate to tropical species is known from East Asia, Papua New Guinea, and Tahiti (Kurokawa 1979, Kurokawa & Lai 2001). It is distinguished from *R. reticulata* (Tayl.) Hale & A. Fletcher by the presence of a white mottled zone near the margin of the lower surface of the lobes, especially when soralia are formed on the upper surface. A detailed description follows.

Thallus loosely adnate, membranaceous to coriaceous, to 12 cm wide. Lobes imbricate or subascending, irregular, partly rounded and deeply crenate, 5–12 mm wide; cilia sparse to moderately dense, simple, 0.2–2.0 mm long; lobes often markedly laciniate in the thallus centre, laciniae digitate, 0.5–1.0 mm wide. Upper surface pale grey to grey-green, dull, finely maculate, maculae forming an intricate network and fissuring into reticulate cracks, sorediate; soralia marginal, capitate, commonly at apices of short marginal laciniae; soredia granular. Lower surface black, with a white mottled, erhizinate zone near the margins; rhizines moderately dense, simple or squarrose, slender, to 2 mm long, black. Apothecia and pycnidia not seen.

Chemistry: Cortex K+ yellow; medulla K+ yellow turning red, C–, P+ orange; containing atranorin, chloroatranorin, salazinic acid (major), and consalazinic acid (minor).

SPECIMENS EXAMINED
Viti Levu: •Nasori Highlands, Nadi-Sigatoka Road, 3.6 km W of Vanturu Dam turnoff, on tree trunk in regrowth forest along roadside, *J.A. Elix 15111*, 26 July 1983 (CANB); •Nadi-Sigatoka Road, 4–13 km E of Vanturu Dam turnoff, on *Dacrydium* in regrowth forest along roadside, *J.A. Elix 15172, 15189, 15240*, 26–27 July 1983 (CANB).

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Additional lichen records from New Zealand 33. *Caloplaca* cf. *concilians* (Nyl.) H. Olivier and *Diplotomma chlorophaeum* (Hepp ex Leighton) Kr.P. Singh & S.R. Singh

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The lichens collected from the mountains of central Otago by Henry A. Imshaug in December, 1972, have remained largely unexamined in the Michigan State University Herbarium (MSC) since they were collected. However, a recent award from the US National Science Foundation has resulted in the re-activation of Dr Imshaug's collections (Fryday 2000). One of these collections is of the dark-fruited *Caloplaca concilians*, one of a species group not previously represented in the New Zealand flora.

The author recently also obtained material of *Rhizocarpon* on loan from CHR as part of a project to revise the genus in New Zealand. One collection has *Lecanora*-type asci and a thallus containing norstictic acid, and is referable to *Diplotomma chlorophaeum*.

These two species are reported for the first time from Australasia, and *D. chlorophaeum* is also new to the Southern Hemisphere.

Caloplaca cf. *concilians* (Nyl.) H. Olivier, *Mém. Soc. Sci. Nat. Cherbourg* **37**: 138 (1909).
Basionym: *Lecanora ferruginea* f. *concilians* Nyl., *Lich. Scand.*: 143 (1861).

Thallus pale grey, areolate. Apothecia numerous, black, ± immersed in the thallus, 0.2–0.3 mm diam. Hamathecium of sparingly branched paraphyses with slightly swollen tips. Epihymenium aeruginose to blue-grey, K+ magenta. Hypothecium brown. Ascospores 15–18 × 8–9 µm, septum 3.5–4 µm long.

This specimen does not fit any of the taxa described by Wetmore (1994), and Dr Wetmore himself has been unable to suggest a name for it. It appears closest to *C. concilians*, "a member of the critical *C. exsecuta / conversa* group, which is widespread all over the world, including Antarctica" (U. Søchting, pers. comm.). This is the first record of a dark-fruited *Caloplaca* from New Zealand.

SPECIMEN EXAMINED: •South Island, Otago: rock tors in alpine zone, summit of Museum Rock, Rock and Pillar Range, 24 km west of Middle March, Taieri County, alt. 1280 m, 6 December 1972, *H.A. Imshaug 56091* (MSC).

Diplotomma chlorophaeum (Hepp ex Leight.) Kr.P. Singh & S.R. Singh, *Bull. Bot. Surv. India* **26**: 64 (1985).
Basionym: *Lecidea chlorophaea* Hepp ex Leight., *Lich. Fl.*: 328 (1871).
Synonyms: *Rhizocarpon chlorophaeum* (Hepp ex Leight.) Müll. Arg., *Flora* **55**: 538 (1872). *Diplotomma chlorophaeum* (Hepp ex Leighton) Szat., *Ann. Mus. Nat. Hungar, n.s. VII*: 280 (1956) (*comb. inval.*).

Thallus whitish, areolate. Apothecia black, lecideine, 0.2–0.6 mm diam. Ascospores brown, 3-septate to submuriform, 15–20 × 8–11 µm. Chemistry medulla Pd+ yellow, K+ red (acicular crystals in microscopic section), I+ blue.

This taxon is characterized within *Diplotomma* by having a thallus containing norstictic acid (K+ red crystals) and an I+ blue medulla. For a long time it had only been recorded from maritime rocks in Macaronesia and Western Europe, from the Azores to the British Isles (Purvis *et al.* 1992), but more recently it has been reported from Manipur, India (Singh & Singh 1985). This record, from mountains in central Otago, represents a further extension of its range and a broadening of its habitat, although it is not unusual for maritime species to occur in mountainous areas as well.

Diplolomma is separated from *Buellia* principally by its 3-septate to submuriform, distoseptate ascospores. Although the generic status of *Diplotomma* is not universally accepted (Nordin 1996, 1999), recent molecular data (Ashwell 2000) indicate that *Diplotomma* does form a discrete group within *Buellia*. The same data also suggest that *D. chlorophaeum* is very closely related to *D. murorum* (A. Massal.) Coppins, and might not warrant recognition as a separate species.

SPECIMEN EXAMINED: •South Island: Otago, Horse Range, 50 miles N of Dunedin, 670 m, on rock, 31 March 1934, *J.S. Thomson 1591* (CHR).

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